Project Status Report for: June 2001

Project Title: Ultra Low NOx Integrated System for Coal-Fired Power Plants

Project Number: 91890460 **Project Manager:** John Marion

Customer Name: U.S. DOE / Performance Projects **Project Leader:** Charles Maney

GOALS AND OBJECTIVES:

Develop low cost, retrofit NO_x control technologies to address current and anticipated, near term emissions control legislation for existing coal fired utility boilers. Specific goals include:

- Achieve < 0.15 lb/MMBtu NO_x for eastern bituminous coals
- Achieve < 0.10 lb/MMBtu NO_x for western sub-bituminous or lignitic coals
- Achieve economics at least 25% less than SCR-only technology
- Validate NOx control technology through large (15 MWt) pilot scale demonstration
- Evaluate the engineering feasibility and economics for representative plant cases
- Provide input to develop commercial guidelines for specified equipment
- Provide input to develop a commercialization plan for the resultant technologies

WORK PLANNED FROM PREVIOUS REPORT:

Task 2.4 – Advanced Control System Design

- Obtain preliminary results of the flame scanner data.

Task 3.5 – Data Reduction and Analysis

- Continue data reduction and analysis from second combustion test period.

Task 5 – Engineering Systems Analysis & Economics

- Begin final economic comparison of the selected ultra-low NOx emission systems.

Task 6 – Advisory Panel

- Schedule the next meeting of the Utility Advisory Panel.

Task 8 – Project Management

- Continue to attempt to come to closure on the modified statement of work provided to DOE in Feb. 2001.
- Hold internal meeting to review data from the second combustion test period.
- Begin discussions with business unit on commercialization plan.

ACCOMPLISHMENTS FOR REPORTING PERIOD:

Task 2.4 – Advanced Control System Design

- *Obtain preliminary results of the flame scanner data.*

As of the date of this report, analysis of the flame scanner data is still on-going. To date, data from 24 test conditions has been extracted from the archived data sets and processed. Correlation of the flame scanner signals with furnace operating conditions and NOx emission levels has not, however, been initiated.

Task 3.5 – Data Reduction and Analysis

- *Continue data reduction and analysis from second combustion test period.*

Data reduction and analysis from the second combustion test period in the BSF has largely been completed. Additional data analysis will be performed as needed during the reporting process.

A summary of the NOx emissions from the 3 coals fired in the BSF is shown in Figure 1. For each coal, a post-NSPS baseline (re. CCOFA only), TFS 2000™, and minimum NOx test condition are reported. Note that for the mvb and hvb coals, all three test conditions were run at a dynamic classifier grind of 85% -200 mesh. The microfine grind of the mvb coal was 96% -325 mesh. As illustrated in Figure 1, a decrease in the NOx emissions is seen as a function of coal rank and firing system configuration. A reduction of 65-75% over the baseline number was achieved with a TFS 2000™ firing system at the optimum main burner stoichiometry. Additional NOx reduction was achieved for each of the coals through optimized combinations of the test variables and is shown as the "Minimum NOx" case.

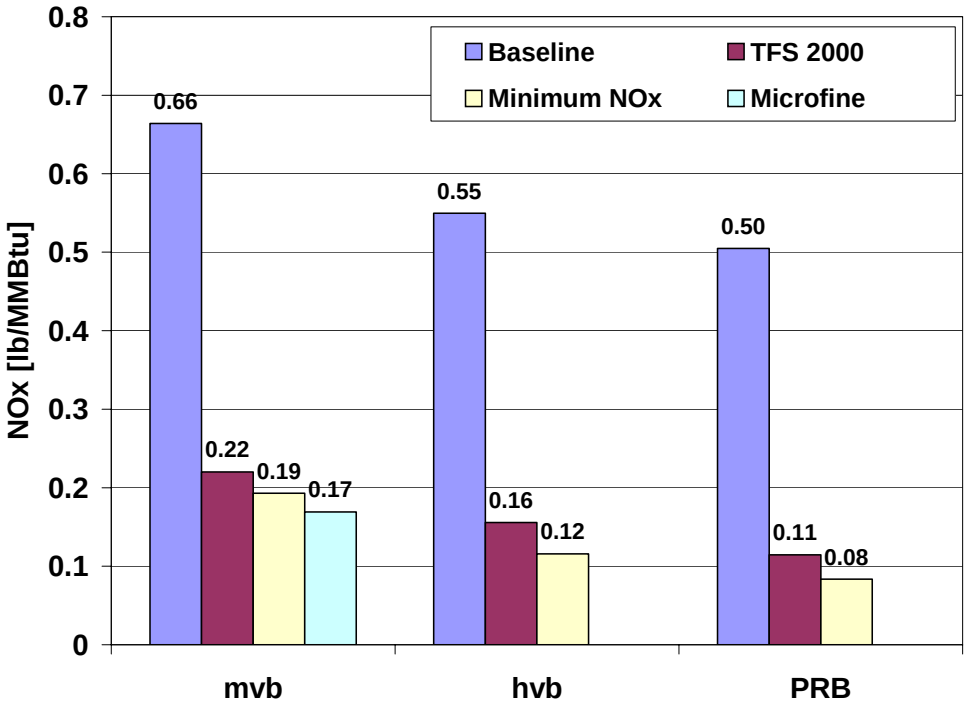

Figure 1. NOx emissions from BSF combustion testing.

Coal flow balancing was investigated in the BSF testing as a means to achieve additional NO reduction. As the ABB Kent Taylor coal flow meters were not found to be accurate enough to actually improve the coal flow balance, the BSF testing utilized increasing levels of imbalance achieved by restricting the coal and air flow to selected coal nozzles. The transport air and coal flow restrictions were achieved by partially closing ball valves that were in each of the 12 coal transport lines, just before the coal nozzles.

Figure 2 illustrates the deviation in the transport air flow as function of ball valve position as measured by orifice plates in each of the 12 coal transport lines. The baseline condition with all of the ball valves open had an average TA flow deviation of 6% (14% max). Closing 4 of the ball valves 33% increased the average TA flow deviation to 14% (20% max) while 66% closure increased the TA flow deviation to 46% (66% max). Previous barrel testing of the coal flow transport system suggested that the coal flow rates decreased as the transport air decreased, but not linearly. Therefore, the conditions tested result in increasing levels of imbalance in the coal and transport air flow.

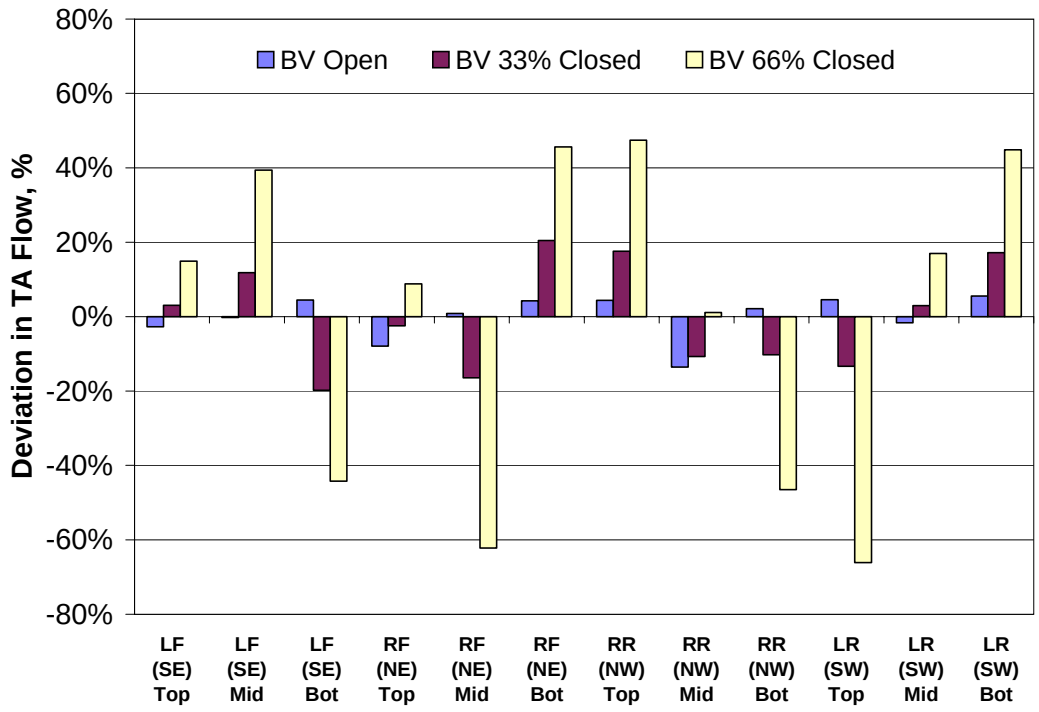

Figure 2. Transport air flow distribution – coal flow balance tests.

However as illustrated in Figures 3-4, increasing levels of coal flow imbalance had little impact on the NOx and carbon in the fly ash in the BSF. For both the PRB and hvb coals there was no significant variation in NOx emissions with increasing coal flow imbalance as shown in Figure 3. As might be expected, there was a small increase in carbon in the fly ash for the hvb coal.

These results suggest that rigorous coal and air flow balancing should not significantly improve the performance of a deeply staged, tangentially fired boiler. However, the modest gains in the carbon in the fly ash by improving balancing may allow for minor reductions in excess air, which may result in slight improvements in NOx emissions and boiler efficiency. Additional field validation of the impact of coal flow balancing on deeply staged, tangentially fired boilers would be desirable.

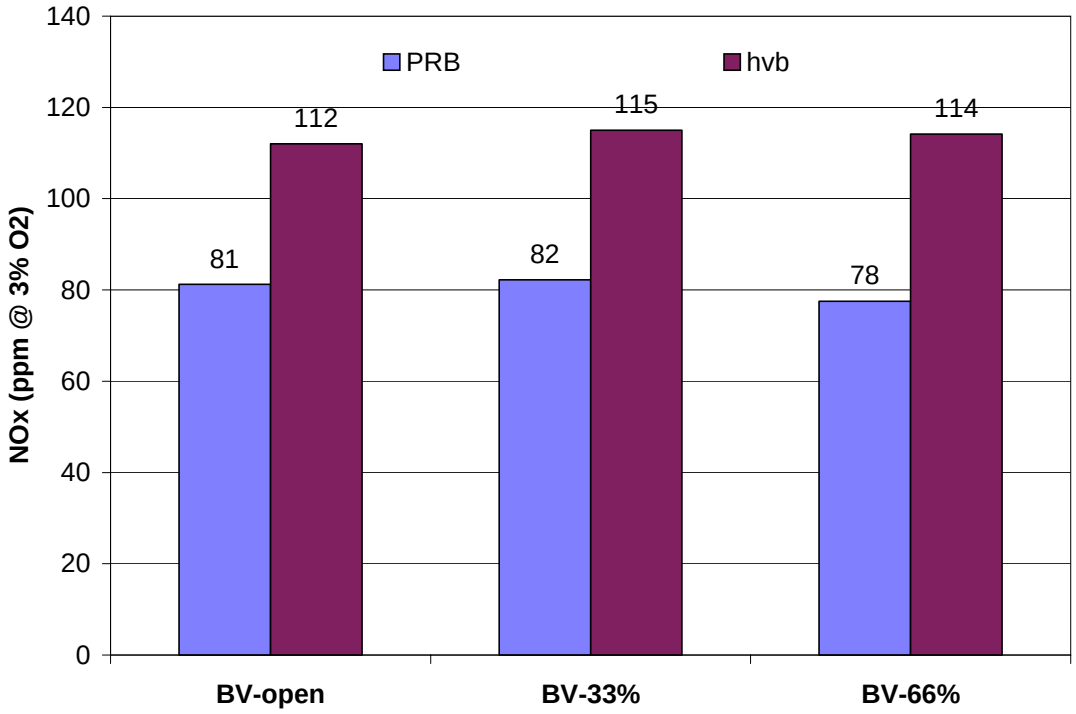

Figure 3. NOx emissions vs coal flow imbalance.

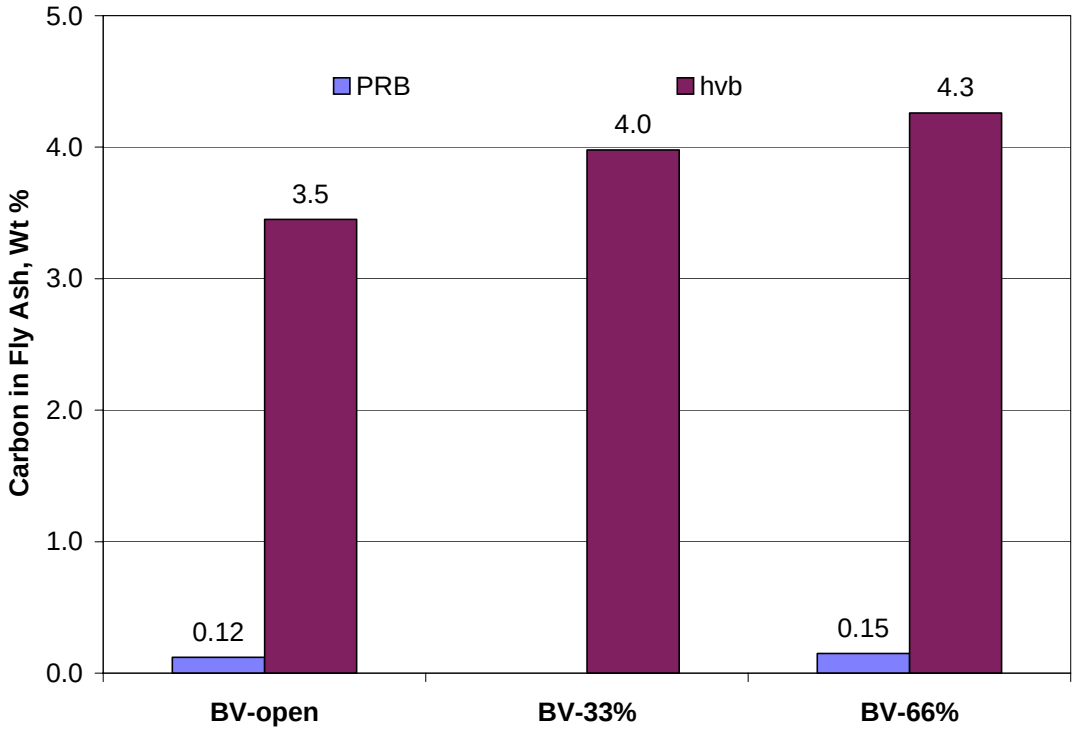

Figure 4. Carbon in ash vs coal flow imbalance.

Task 5 – Engineering Systems Analysis & Economics

- *Begin final economic comparison of the selected ultra-low NOx emission systems*.

Meetings were held to discuss the scope of the economic evaluation in June. While the final units for the analysis have not yet been selected, current efforts revolve around the evaluation of previously considered IP&L and Scottish Power units, as recommended by the advisory panel in our Jan. 31, 2001 meeting. Still at issue is final definition of the to be evaluated subsystems and / or operating conditions, as merited through the results of the pilot scale test campaign. Final decisions on this, and start of the work will be made in late July.

Task 6 – Advisory Panel

- *Schedule the next meeting of the Utility Advisory Panel*.

The next meeting of the Utility Advisory Panel, previously planned for June, 2001, has not yet been formally rescheduled. However a tentative time frame of September, 2001 is desired to allow completion of test data reduction, and initiation of the economic evaluation work.

Task 8 – Project Management

- *Continue to attempt to come to closure on the modified statement of work provided to DOE in Feb. 2001*.

An amendment to the Cooperative Agreement with DOE for this project was received from DOE on June 25, 2001 which incorporates the revised statement of work proposed by Alstom in Feb. 2001. The amendment also extended the project performance period from Oct. 20, 2001 to Dec. 31, 2001.

The agreed to work scope modifications include:

1) DTFS pyrolysis and TGA char reactivity will only be performed on the hvb coal.

2) Impact of reduced PA:fuel ratio tested with existing PA fan. A fuel-air separation system will not be tested.

3) CFD modeling task will be limited to the parametric runs performed before the BSF testing. No additional modeling of the “as fired” test conditions will be performed.

4) Neural network modeling of the BSF test data will not be performed.

5) The online carbon in ash sensor was removed from the project scope.

6) Evaluation of alternate heat recovery systems for application of the CBO™ system will not be made.

7) The economic and engineering analysis scope will be reduced to eliminate the detailed boiler performance modeling and may be limited to a single unit.

- *Hold internal meeting to review data from the second combustion test period*.
- *Begin discussions with business unit on commercialization plan*.

Meetings were held in June with Alstom business unit personnel to review the data from the second combustion test period in the BSF and discuss potential commercial implications. As a result of this meeting, a press release is in the process of being drafted to begin promotion of the technological advances demonstrated as part of this project work. Internal discussion of the commercialization path for system enhancements is on-going, with an effort to bring promising new technologies to the market as soon as possible to meet the needs of current and pending emissions control regulations.

WORK PLANNED FOR NEXT REPORTING PERIOD:

Task 2.4 – Advanced Control System Design

- Obtain preliminary results of the flame scanner data.

Task 3.3 – Combustion Testing and Cleanup

- Finalize scope of cleanup from the second combustion test period in the BSF.

Task 5 – Engineering Systems Analysis & Economics

- Select the units for and define the parameters to be evaluated during the performance of the final economic analysis task.